

SCIENCE

101

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Boundary of the Latest Glaciation in Arctic Canada: DR. WILLIAM HERBERT HOBBS 549

Woodley, Executive Assistant of the American Association for the Advancement of Science: DR. MURTON E. LIVINGSTON 551

Recent Deaths 552

Scientific Events:

Food and Agricultural Organization in India; The Food Standards Committee of the Food and Drug Administration; The Bell Telephone Laboratories at Murray Hill, N. J.; The Wisconsin Junior Academy of Science; The Kansas Academy of Science 553

Scientific Notes and News 556

Discussion:

Hepatic "Inactivation" of Estrogens: DR. A. MANTAROW, DR. K. E. PASCHKIS and A. E. RAKOFF. A Possible Case of Fictitious Continental Drift: WALTER D. LAMBERT. Fossil Discovery near San Francisco: DR. FRANK M. STANGER 558

Scientific Books:

Argasidae: ROBERT MATHESON. Theory of Functions: PROFESSOR GARRETT BIRKHOFF 561

Special Articles:

Glucuronic Acid as a Measure of the Absorption of Penicillin: DR. DAVID PERLSTEIN and OTHERS. Non-Acid-Fast Forms of the Mycobacterium of

Human Leprosy: DR. ELEANOR ALEXANDER-JACKSON. The Activity of a Bacteriostatic Substance in the Reaction between Bacterial Virus and Host: DR. THOMAS F. ANDERSON. The Local Anesthetic Properties of Isonipeccaine: DR. E. LEONG WAY 562

Scientific Apparatus and Laboratory Methods:

Intravenous Tubing for Parenteral Therapy: DR. B. ZIMMERMANN. A Device for Measuring Avena Coleoptile Curvature: DR. WESLEY P. JUDKINS 567

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THE BOUNDARY OF THE LATEST GLACIATION IN ARCTIC CANADA

By Dr. WILLIAM HERBERT HOBBS
UNIVERSITY OF MICHIGAN

THE northern boundary of the latest (Wisconsin) glaciation of the North American continent has never been mapped by glacialists;¹ and until the modern glaciation era had opened, an exploring expedition was necessary even to gain access to the region.

As all glacialists are aware, the area covered by the latest glaciation is everywhere characterized by the occurrence of a peculiar type of glacial lake with many bays and islands, and these lakes are found in great numbers—in myriads wherever the relief is low

and the glacial topography dominates the landscape.²

Lakes are features of short lives in a geological sense, and they have not survived from any of the three earlier glaciations of the Pleistocene (in case these glaciations have extended beyond the borders of the Wisconsin). The dividing line between lakes and lakeless country in arctic Canada may therefore be assumed to approximate the boundary of the latest

¹ See E. Antevs, "The Last Glaciation," *Amer. Geol. Soc., Research Series*, no. 17, p. 75, 1925. See also *Geol. Soc. Amer., Bul.*, vol. 40, pp. 631-720, 1929.

² See Map of the Northwest Territories and Yukon, by the Hydrographic and Map Service of Canada, Surveys and Engineering Branch, Dept. Mines and Resources, scale 80 miles to the inch, 1939. Also, Map of Canada, *Nat. Geog. Soc.*, scale 93 miles to the inch, 1936.

glaciation. There are of course other distinguishing marks of that glaciation: the glacial striae on exposed rock surfaces, as well as glacial deposits—the moraines along or parallel to the boundary, and the serpentine eskers (and perhaps also local drumlins) perpendicular to it. These depositional features, unlike the striae, can be often seen and mapped from the air; the eskers particularly, which appear widely distributed and stand out sharply on the air photographs.

Long held back by lack of roads, geologists are now able to enter the Canadian wilderness in planes, which can land on the lakes almost anywhere, using pontoons during the summer and skis on the snow-blanketed lakes in the winter season. A very considerable part of the Dominion has now been mapped from the air in photographs which have not been excelled for detail and clarity. For the entire domain sectional hydrographic maps have now been issued on a scale of eight miles to the inch, some based on air photographs, others on one or more canoe traverses only, but all revealing all the hydrography that is known. With these sectional maps as a guide it is now possible to draw a dividing line between lakes and lakeless country, and this affords us a first approximation to the northern border of the Wisconsin glaciation (see map of Fig. 1).



FIG. 1. Sketch-map to show the approximate northern boundary of the Wisconsin glaciation of North America in Canada and the distribution of the glacial loess of the periglacial area. Between, perhaps masked by a thin veneer of loess, is the zone of outwash gravel.

To a greater degree of approximation it should now be possible to fix this glacial boundary by a flight, using a plane with such photographing equipment as is extensively employed for patrols before the battle fronts. Flying at 10,000 feet altitude a zone twenty miles in width could be mapped, always keeping in view to the south the border of the lake country. This will be crucial where the border crosses Banks, Prince of Wales, Somerset and Baffin islands of the American archipelago.

Studies of the Greenland continental glacier have shown³ that outside the outwash plain along its front, which is made up of gravel, sand, silt and clay with

³ Wm. H. Hobbs, *Am. Philos. Soc., Proceedings*, vol. 86, no. 3, pp. 368-384, 1943.

stranded boulders, there is a broad area of once borne silt many tens of miles in width. Laid down by glacial meltwater during the summer, the outwash becomes during winter seasons a deflation area from which the silt is lifted by the outward-blowing storm winds of the glacial anticyclone and deposited outside where lack of the flooding permits the growth of tundra vegetation. These loess deposits of glacial origin are thickest at the margin of the outwash, and they thin out at greater distances.

Such deposits have been found surrounding the outwash of all the areas of Pleistocene glaciation (see for example, map of Fig. 2). The loess deposits

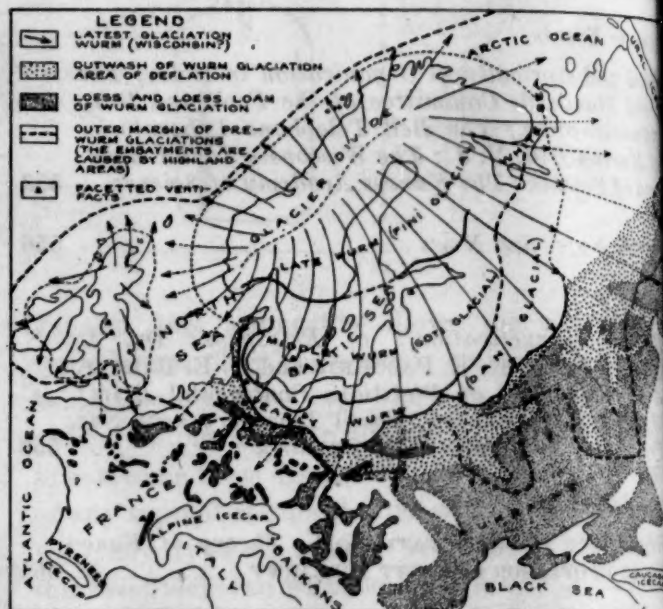


FIG. 2. Map of the outwash and loess deposits which surround the latest (Wurm) glaciation of Europe. The arrows show wind directions of glacial anticyclone (after *Amer. Jour. Sci.*, May, 1943).

which rest upon the pre-Wisconsin glacial formation of the Upper Mississippi and Missouri valleys have already been described.⁴ The silt deposits of the arctic tundra in Canada are the loess deposits off the northern border of the glacier, as those of the United States are off the southern. The same fauna of air-breathing mammals of Pleistocene age is common to both, the elephants especially).

This silt, like deposits of loess throughout the world, is unleached and hence a rich soil.⁵ Because of long hours of solar radiation during the arctic summer and despite the shortness of the season, a limited agricultural development is here possible, as lately has been proven in Alaska and in the Soviet arctic, where nearly identical conditions are found. This is supplemented by a reindeer (caribou) and in Canada by a possible musk-ox (ovibos) industry, for which the tundra vegetation supplies the browse.

⁴ See footnote 3. Also *SCIENCE* of September, 10, 1943, pp. 227-230.

⁵ *Scientific Monthly*, vol. 57, pp. 289-300, October, 1943.

Since the Wisconsin glacier advanced northward over richly mineralized crystalline rocks, the probability that the gravel of the arctic outwash zone is very great. These conditions are those of the Alaskan "golden heart," except that in that mountainous country there has been a further concentration in the bottoms of deep valleys.

It is already foreshadowed that in the postwar period the polar basin is to be crossed by flight-routes from North America to the Far East. Re-lying stations must be set up on the coast of arctic

Canada and in the American archipelago as far north as possible. The outwash belt will supply the gravel for the highways which must enter the area from the Mackenzie and Alcan routes, since the pack-ice off the arctic coast has thus far made sea communication difficult. Radio and airplane stations at close intervals and icebreakers may however later transform it into a "Northern Sea Route" like that of the Soviet arctic. Baffin and Somerset Islands at the east can be reached by sea from the Lancaster Sound west of Baffin Bay.

SAM WOODLEY

Executive Assistant of the American Association for the Advancement of Science

By Dr. BURTON E. LIVINGSTON

THIS note is to mark the recent completion of Sam Woodley's first quarter century of service to the American Association. Although relatively few members have had the good fortune to work with Mr. Woodley for long periods, yet the many thousands who have attended our meetings in the last twenty-five years will with pleasure how he has arranged and directed registration, how he has provided the very convenient "visible directory" of registrants, how he has cared for a general information service to answer all manner of questions, how he has arranged to provide lanterns, screens and microscopes for the numerous scientific sessions. He has been most widely known, known of, through his genius for such details, but his long service to science and to the American Association has been much farther-reaching than observation at our meetings might indicate. I propose to present here a brief outline of Woodley's background and to mention some of the services he has been giving to the association.

Sam Woodley was born on May 25, 1889, in Coal City, Illinois. His father, William Henry Palmer Woodley, had come to this country from England, and his mother, née Ann Cooper, had come from Scotland. Attending the public schools through the grammar grades, the boy became first acquainted with commercial and office work by helping in his father's grocery and by aiding his uncle in the office of a coal company. When he was fourteen years old the family moved to Kewanee, where he worked about two years in machine shop and boiler factory, devoting much of his free time to the study of bookkeeping through a correspondence-school course. He then became bookkeeper for a drayage company, later for a grain elevator. Meanwhile, his evenings were largely given over to the study of stenography and typing at a local school. His eighteenth year found him employed in cost accounting at the Kewanee works of the National Tube Company, where he remained, with several promotions, till 1915.

Having been enrolled in the U. S. Civil Service after passing the official examination for stenographers, Woodley received an appointment in the Division of Publications of the U. S. Department of Commerce and moved to Washington, D. C., in that year. After three more years, he was placed in charge of the bookkeeping section of the division. He must have gained a great deal of valuable experience in cost accounting, budget estimating and the like, in connection with the many publications of the Department of Commerce, and by the end of 1919 he seems to have felt ready to seek some new field of employment, hoping to find opportunity for broadening his education and for further growth. So he placed an advertisement in the personal column of the *Washington Star* for January 31, 1920, stating some of his qualifications and asking consideration by any one who might possibly employ him. It was through that advertisement that I first became acquainted with Sam Woodley and he came within the ken of the American Association for the Advancement of Science.

It will be remembered by many that Dr. L. O. Howard was elected president of the association on January 1, 1920, when he had completed his twenty-seventh year of able and devoted service as permanent secretary, and that I was elected to succeed him in the Washington office. As the new permanent secretary, I was to devote about half-time to association affairs and I found that my first job was to try to secure a competent assistant. By good fortune, I read Mr. Woodley's advertisement, answered it and asked him for a conference. By March 1 he had become executive assistant and office manager for the association.

We began at once to revise and plan arrangements for handling association affairs. We had the benefit of advice and suggestions from such experienced men as President L. O. Howard, Treasurer R. S. Woodward, General Secretary D. T. MacDougal and Editor J. McKeen Cattell. Additional clerical help was soon

employed, as Woodley rapidly came to understand our needs. As one of the association officers once said, Woodley proved to be "a whirlwind at getting things done." From the beginning, he showed remarkable ability, capacity and reliability, not only along many lines of clerical work but also in general executive management. He showed understanding and enthusiasm and he obviously liked his new position.

For years his evenings were partly devoted to the advancement of his own formal education in his chosen field. By 1926 he had completed the high-school course and had attained the bachelor's degree and the master's degree in commercial science at Southeastern University. He rapidly developed a highly appreciative and sympathetic understanding of the ideals of professional scientists and the aims of the association.

The Woodleys were married at Kewanee in 1912. Mrs. Woodley, whose parents were of old Pennsylvania stock, was Icy Dora Miller. Since October, 1924, she has been a most valuable assistant in the Washington office of the association, having charge of the complex details of the membership and subscription records, to which she devotes precise and constant care; many members will remember her as a very busy person in the registration offices at some of the association meetings. She keeps the books, writes outgoing checks and handles annually in recent years about thirty-five thousand incoming checks for dues and other payments. Mr. Woodley always gives to her much credit for the smooth operation of the office in carrying out the instructions of the executive committee and of the permanent secretary.

The Woodleys have a convenient and attractive home near Rock Creek Park, with two devoted pet cats and a garden of both ornamental and vegetable plants. Their daughter, Priscilla, a graduate of Washington College of Music and of Wellesley College, is the wife of Charles F. Tank, a West Point graduate who is now a Lieutenant Colonel in the Corps of Engineers, U. S. Army. They have two little daughters.

Woodley has worked with four permanent secretaries of the association, to all of whom he has given loyal and affable cooperation at all times. With the growth of our organization, his responsibilities have naturally broadened and increased throughout the years. He has served as secretary of the executive committee at more than a hundred of its business sessions. In a similar way he has served the finance

committee also, which manages the association's investment portfolio. He has prepared the annual financial reports for the permanent secretary and treasurer, and the reports made by the association to the U. S. Bureau of Internal Revenue. For the permanent secretary and the local committees, he arranged the complex details of many association meetings, including the publication of the general programs, sizeable books that must be edited, printed and bound in the hectic hours just before a meeting opens. He has had charge of the preparation and publication of four volumes of the "Summarized Proceedings" and the accompanying directories of members. The recurring circularization for new members is another of his many jobs. The American Association has been fortunate in having Woodley on its staff for twenty-five years and we hope that his service will continue for an additional quarter century and longer.

I now add a few quotations from some of those who have worked closely with Woodley. "His outstanding characteristics are his efficiency and his failing good nature. He has an uncanny ability to segregate the essential from the unessential. In emergencies he never loses his head or shows irritation." "The most prominent characteristic of Sam's personality is shown by his quiet, self-reliant, cordial operation with others and his generous habit of giving full credit to his associates for accomplishments toward which he has personally devoted a great deal of time and thought."—"If he ever makes a mistake he is always ready to correct it promptly, and if one of his associates makes a mistake he uncomplainingly pitches in to set things right."—"Throughout the years we have all recognized in Sam the most effective type of intelligent, informed and devoted service. Local committees for association meetings have many times expressed their admiration and their appreciation of his great contributions of study and effort to further the success of the meetings. He is a most efficient office manager."—"Both Mr. and Mrs. Woodley rank exceptionally high in intellectual integrity, in intelligence and in industry and the ability to get work done in spite of difficulties."—"Besides being constantly devoted to the larger projects and problems of the association, Sam is ever alert to care for trivial troubles before they can become important. When need arises, he gladly and ably becomes the handy man of the Washington office."

OBITUARY

RECENT DEATHS

DR. HORACE CLARK RICHARDS, emeritus professor of physics of the University of Pennsylvania, died on May 20 at the age of seventy-seven years.

DR. HAROLD ORVILLE WHITNALL, head of the department of geology and geography of Colgate University, died on May 18 at the age of sixty-seven years.

DR. LEE MAIDMENT HURD, since 1932 emeritus pro-

1, 1945

of laryngology of New York University and Bellevue Hospital Medical College, died on May 15. He was seventy-one years old.

The death is announced of H. C. Moreno, professor of mathematics of Stanford University.

THOMAS ARCHIBALD WRIGHT, president of Lucius W. Wright, Inc., consulting chemists, of New York City, died on May 25 at the age of fifty-eight years.

The death in April is announced of Lieutenant Clifford M. Wheeler (M.C.), U.S.N.R. Prior to his naval service, Lieutenant Wheeler was an instructor in the department of preventive medicine at Harvard Medical School. He was appointed assistant professor of epidemiology in the DeLamar Institute of Public Health of Columbia University, but

never worked on his appointment, being given a leave of absence for service. Lieutenant Wheeler was accidentally killed in a land mine explosion in Yugoslavia while serving as a member of the U. S. Army Typhus Fever Commission.

DR. STANLEY WELLS KEMP, since 1936 director of the Plymouth Laboratories of England, and secretary to the Marine Biological Association of the United Kingdom, died on May 16 at the age of sixty-four years.

ALEXANDER FERSMAN, the mineralogist, a director of the Museum of the Academy of Sciences of the U.S.S.R., director of the Geographical Institute and chairman of the Institute of Archeological Technology, died on May 20 at the age of sixty-two years.

SCIENTIFIC EVENTS

FOOD AND AGRICULTURAL ORGANIZATION IN INDIA

THE Government of India has accepted the constitution of the permanent Food and Agricultural Organization (F.A.O.) of the United Nations, drawn up by the United Nations Interim Commission appointed in July, 1943, to prepare for submission to governments a specific plan for a permanent International Organization for Food and Agriculture as recommended by the Hot Springs Conference.

The broad objectives of the Food and Agricultural Organization, as set forth in the preamble to the constitution and printed in *The Journal of Scientific and Industrial Research*, are:

- (1) to raise the levels of nutrition and standards of living among the peoples of the world,
- (2) to secure improvements in the efficiency of the production and distribution of all food and agricultural products,
- (3) to better the conditions of rural populations, and
- (4) to contribute by these means towards an expanding world economy.

The member nations undertake to report to one another through the Food and Agricultural Organization on the measures taken and the progress achieved in these fields of action.

The methods to be employed by the Food and Agricultural Organization are indicated in Article I of the constitution, which outlines the functions of the organization:

- (1) The organization shall collect, analyze, interpret and disseminate information relating to nutrition, food and agriculture.
- (2) The organization shall promote and, where appropriate, shall recommend national and international action with respect to

(a) the scientific, technological, social and economic research relating to nutrition, food and agriculture;

(b) the improvement of education and administration relating to nutrition, food and agriculture, and the spread of public knowledge of nutritional and agricultural science and practice;

(c) the conservation of natural resources and the adoption of improved methods of agricultural production;

(d) the improvement of the processing, marketing and distribution of food and agricultural products;

(e) the adoption of policies for the provision of adequate agricultural credit, national and international;

(f) the adoption of international policies with respect to agricultural commodity arrangements.

(3) It shall be the function of the organization

(a) to furnish such technical assistance as governments may request;

(b) to organize, in cooperation with governments concerned, such missions as may be needed to assist them to fulfil the obligations arising from their acceptance of the recommendations of the United Nations Conference on Food and Agriculture; and

(c) generally to take all necessary and appropriate action to implement the purposes of the organization as set forth in the preamble.

The Food and Agricultural Organization will include in its scope forestry and fisheries as well as agriculture. It will be concerned not only with food but with non-food agricultural products, such as fibers and oils, and with the primary products of forests. Nutrition as well as the production, processing and marketing of foods will lie within its field of activity.

THE FOOD STANDARDS COMMITTEE OF THE FOOD AND DRUG ADMINISTRATION

A MID-JUNE meeting of the Food Standards Committee of the Food and Drug Administration has been

called. This will be the first meeting of the committee since the beginning of the war. The committee has been requested to make recommendations on the following subjects:

Amendment of the present definitions and standards of identity for cheddar, washed curd and colby cheeses to require that they be made from pasteurized milk or that they be stored for specified periods before they are marketed.

Adoption of definitions and standards of identity for additional cheeses such as Swiss, brick, limburger, etc.

Adoption of definitions and standards of identity for various process cheeses and related products, such as cheese foods, cheese spreads, etc.

Adoption of definitions and standards of identity for various foods prepared from corn, such as corn meal, bolted corn meal, degerminated corn meal, corn flour, enriched corn meal, enriched grits, etc.

Due to existing governmental travel restrictions the committee will hold no open meetings but invites any interested person, particularly members of industries, representatives of trade associations, consumer organizations, state and city officials, to transmit by mail any suggestions, recommendations or factual data bearing on the subjects to be considered. Such communications should be addressed to Joseph Callaway, Jr., secretary, Food Standards Committee, Food and Drug Administration, Washington 25, D. C., and should arrive before June 9.

A more detailed outline of the particular questions in connection with the foods under discussion about which the committee would particularly like expressions of opinion, can be obtained from the secretary of the committee.

The Food Standards Committee is made up of four state enforcement officials and two members of the Food and Drug Administration. These are Mrs. F. C. Dugan, director of the Bureau of Food, Drugs and Hotels, of the Kentucky State Department of Health; Guy G. Frary, director of the Division of Inspections of the South Dakota Department of Agriculture and State Chemist; J. J. Taylor, State Chemist of the Florida Department of Agriculture; Dr. Wm. F. Reindollar, chief of the Bureau of Chemistry of the Maryland Department of Health. The members of the Food and Drug Administration are Dr. W. B. White, chief of the Food Division, and W. A. Queen, chief of the Division of State Cooperation, who is chairman of the committee.

Preliminary consideration by the committee of problems connected with formulation of standards for these foods should not be confused with public hearings which must be held as required by law before standards for these foods can be adopted.

THE BELL TELEPHONE LABORATORIES AT MURRAY HILL, N. J.

As soon as war restrictions permit, the facilities of the Bell Telephone Laboratories at Murray Hill, N. J. will be greatly augmented, according to an announcement made by Dr. Oliver E. Buckley, president of the laboratories. The proposed addition is of approximately the same size as the initial buildings, which were opened in 1941 and cost more than \$2,000,000. The new building will extend the lines of the present one about five hundred feet in a northeasterly direction. Old and new buildings will be joined by a bridge with a sheltered bus terminal beneath.

Since the present building was opened in the fall of 1941, about one hundred groups from varied industries, Government departments and some from abroad have come to study its new features. A unique requirement of a laboratory is that it must be designed for change. Prominent among new features which visitors come to see are the quickly movable partitions and the ease with which wires, cables and pipes may be installed or removed and yet concealed from view.

There are no permanent partitions in the building except those around the stair wells and elevator shafts. All others are built of easily movable metal panels. The outside surfaces of these units are sheet steel and they are separated by a three-inch space which is packed with rock wool to prevent the transmission of sound and heat. Doors and transoms are made of one unit which can be interchanged with a partition in any part of the buildings. Along the outside walls of the buildings there is sheet-steel wainscoting under the windows and up the piers between them. This wainscoting is removable without special tools to give access to service pipes and wiring which are installed behind it. Similar wainscoting is applied around the interior columns.

At intervals, small wings jut out from the main building, providing well-lighted offices for physicists, chemists and engineers conveniently close to their laboratories. Shops, library, medical department and restaurant all fit into the pleasing functional pattern. The fields and woods, courtyards and shaded lawns all tend to make it a pleasant place in which to work.

People are all important to an institution whose products are discovery, invention and design—creations of the intellect. In choosing this two-hundred-acre site the Bell Telephone Laboratories management sought a pleasant and healthful countryside in the midst of desirable home communities which spread over a wide area in towns along the Orange Mountain Range and the adjoining valleys. There is no intention

JUNE 1, 1945

tion of creating a company community in the immediate vicinity of the buildings. Murray Hill is about twenty-five miles from New York headquarters.

The executive offices of the Bell Telephone Laboratories will continue to be at 463 West Street, New York City, and a majority of the employees will continue to work there. With the addition at Murray Hill, however, about two thousand employees will work at the new location compared with more than one thousand employed there during the war. This will include all the research work and most of the work of apparatus development.

Though designed for peace-time use, the present new laboratory opened just as war was breaking and its new and adaptable space proved to be a great aid to Bell Laboratories' war service. Within its walls scores of war projects have been started, some small and completed quickly, others large and expanding from a room to whole sections of the building. The completion of the Murray Hill building project will find the Bell Telephone Laboratories well equipped to design better and more economical telephone and radio equipment for the Bell Telephone System. It will also be ready and equipped to continue its record of achievement in developments for the Army and Navy as they may have need for its services in the future.

THE WISCONSIN JUNIOR ACADEMY OF SCIENCE

APPROXIMATELY two hundred delegates from the clubs of the high schools in the Milwaukee area of the Wisconsin Junior Academy of Science met on May 20 at Marquette University to present scientific papers and demonstrations based on research work in high school. Two annual honorary memberships in the American Association for the Advancement of Science and several annual memberships in the Wisconsin Academy of Sciences, Arts, and Letters were awarded.

The Wisconsin Junior Academy of Science was formed last fall, under the joint sponsorship of the University of Wisconsin and the Wisconsin Academy of Sciences, Arts, and Letters, for the purpose of the discovery and development of scientific talent among the high-school pupils of Wisconsin. The project is under the supervision of Dr. John W. Thomson, assistant professor of botany at the University of Wisconsin. The organization is comprised of members of high-school science clubs from the entire state.

To supplement its work in encouraging individual research work among high-school students, the Junior Academy of Science is planning to sponsor a news bulletin reporting activities and research work beginning next fall, to be circulated among the clubs. Two cooperative projects with the scientific men of the state are being planned—one a study of the distri-

bution of Wisconsin trees and the other a collection of data on the blossoming and fruiting of common wild flowers and trees.

THE KANSAS ACADEMY OF SCIENCE

THE seventy-seventh annual meeting of the Kansas Academy of Science was held at Kansas State College, Manhattan, on April 14, with Dr. L. D. Bushnell, of the Kansas State College, presiding. An affiliated society, the Kansas Entomological Society, met with the academy. The local chapter of the American Association of University Professors held a meeting in cooperation with the academy.

In deference to the restrictions of the Office of Defense Transportation on the holding of general meetings, the meeting at Manhattan was local in character. The executive committee met at this time for the transaction of business. The meeting was small and was limited to the morning and afternoon, but this was the best means possible under the circumstances of maintaining the academy as an active organization. The general enthusiasm of those attending and the character and number of papers offered served to justify the decision to hold the meeting.

The morning was devoted largely to council and business meetings. The invitational address, entitled "Recent Advances in Plant Science," was given by Dr. Walter F. Loehwing, head of the department of botany, University of Iowa, at 10:00 A.M. before a combined college and academy assembly. This part of the program was broadcast over the radio of the Kansas State College, station KSAC, for the benefit of absent members and friends of the academy.

A noon-day luncheon was substituted for the usual annual evening banquet. At this time Dr. Leland D. Bushnell as retiring president gave an address entitled "Microorganisms and a Struggle for Existence."

During the afternoon section meetings were held for botany, chemistry, geology, physics, psychology and zoology. There was no meeting of the Junior Academy, but local chapters were encouraged to hold meetings. A ten-dollar award was offered to the Junior Academy doing the most outstanding work during the year. The total attendance was 116.

The following officers were elected for next year: *President*, Dr. John W. Breukelman, Kansas State Teachers College, Emporia; *President-elect*, Dr. Claude W. Hibbard, University of Kansas; *Vice-president*, Dr. John C. Peterson, Kansas State College; *Secretary*, Dr. Donald J. Ameel, Kansas State College; *Treasurer*, Dr. F. W. Albertson, Fort Hays Kansas State College; *Executive Council Members* (additional), Dr. L. D. Bushnell, Kansas State College; Dr. H. H. Lane, University of Kansas; Dr. Paul Murphy, Kansas State Teachers College, Pittsburg; and Miss

Edith Beach, Lawrence High School. Dr. Robert Taft, University of Kansas, continues as editor. Dr. Mary T. Harman and Dr. A. B. Cardwell, Kansas State College, were elected associate editors for a term of three years, and Dr. W. H. Schoewe, Univer-

sity of Kansas, was elected to serve a two-year term as associate editor. Dr. M. J. Harbaugh, Kansas State College, was elected librarian of the academy.

DONALD J. AMERL

KANSAS STATE COLLEGE

SCIENTIFIC NOTES AND NEWS

DR. VANNEVAR BUSH, president of the Carnegie Institution and director of the Office of Scientific Research and Development, was presented on May 25 at a dinner meeting of the National Institute of Social Sciences in New York City with one of the gold medals awarded by the institute. The medal was awarded for "distinguished services in the field of science, in engineering education and in the application of research to the solving of problems of fundamental value to civilization." The presentation was made by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology.

DR. ELMER D. MERRILL, administrator of Botanical Collections of Harvard University and director of the Arnold Arboretum, was elected on May 8 a corresponding member of the Academy of Sciences of the Institute of France to fill the vacancy caused by the death of Dr. S. Ikeno, of Tokyo.

At the ninety-second annual commencement of the University of Wisconsin, the doctorate of laws was conferred on Dr. William E. Wickenden, president of the Case School of Applied Science, Cleveland.

THE honorary doctorate of science was conferred on April 30 at the one hundred and twelfth commencement of Denison University on Dr. Carey Croneis, formerly professor of geology at the University of Chicago, now president of Beloit College, in recognition of his achievements "as a brilliant discoverer and interpreter of ancient forms of life, and a thorough and patient teacher of earth science."

THE honorary degree of doctor of science of Fordham University was conferred on May 24 on Dr. William J. Robbins, director of the New York Botanical Garden, at a special convocation in commemoration of the fiftieth anniversary of the garden.

THE Thomas Burr Osborne Gold Medal of the American Association of Cereal Chemists was presented on May 15 at a dinner in New York to John O. Baker, vice-president and director of Wallace and Tiernan Company, Inc. It was the first time that this award had been made for work in the industrial field. The medal was established in 1926, to signalize distinguished contributions to cereal chemistry. It has only been granted five times before and always for work in pure science and teaching.

THE Lamme Medal "for meritorious achievement in engineering or the technical arts" of the Ohio State University has been awarded to Taine G. McDougal, vice-president of the AC Spark Plug Division of the General Motors Corporation, Detroit. Presentation will be made at the commencement exercises of the university on June 8.

THE prize in pure chemistry of \$1,000 of the American Chemical Society for 1945 has been awarded to Dr. Frederick T. Wall, associate professor of physical chemistry at the University of Illinois, in recognition of his work on the thermodynamics and statistical mechanics of polymers. The award is made annually to encourage fundamental studies by young chemists working in North America.

DR. KATHARINE B. BLODGETT, of the General Electric Research Laboratory, Schenectady, N. Y., has received the Achievement Award of \$2,500 given by the American Association of University Women for distinguished research in developing films of almost infinitesimal thickness.

THE twenty-second annual meeting of the chapter of Sigma Xi at the University of Virginia was held on the evening of May 3. President Fred L. Brown received into membership seven associates and seven members. Dr. Julian F. Smith, of the Institute of Textile Technology, Charlottesville, Va., gave the annual address. The twenty-first award of the President and Visitors' Research Prize in the Natural Sciences and Mathematics was presented by President John L. Newcomb, of the University of Virginia, to Lester Van Middlesworth, Raymond F. Kline and Sydney W. Britton for their published work, "Carbohydrate Regulation under Severe Anoxic Conditions."

THE University of Rochester chapter of Sigma Xi held on May 3 its initiation ceremonies for new members and the installation of officers for 1945-1946. The new officers are: *President*, Dr. K. E. Mason, of the Medical School; *Vice-president*, Dr. C. F. H. Allen, of the Eastman Kodak Research Laboratories, and *Secretary-Treasurer*, Dr. C. D. Kochakian, of the Medical School. New members of the *Executive Committee* are Dr. Frances L. Haven, Medical School, and Dr. Roger P. Loveland, Eastman Kodak Research Laboratories. *Membership Committee*: Dr. A. B. F.

JUNE 1, 1945

mean, chemistry, and Dr. John Coakley, psychology. After the ceremonies Professor L. C. Dunn, of Columbia University, spoke on "Scientific Research after the War."

OFFICERS of the Royal Astronomical Society, London, have been elected as follows: *President*, Professor H. H. Plaskett; *Vice-presidents*, Dr. E. C. Bullard, Sir Harold Spencer Jones, Professor E. A. Milne and J. J. Sellers; *Treasurer*, J. H. Reynolds; *Secretaries*, Dr. H. R. Hulme and D. H. Sadler; *Foreign Secretary*, Professor F. J. M. Stratton.

THE retirement on July 1 is announced of Dr. John R. Murlin, professor of physiology and director of the department of vital economics at the School of Medicine and Dentistry of the University of Rochester.

DR. LARS ONSAGER, associate professor of chemistry at Yale University, has been promoted to the Josiah Willard Gibbs professorship of chemistry.

DR. HENRY S. CONARD, professor emeritus of botany of Grinnell College, Iowa, has been appointed visiting research professor for the academic year 1944-1945 at the State University of Iowa. During the months of April, May and June, he is in residence at the university, working in the moss herbarium and writing a descriptive account of the vegetation of Iowa.

DR. RICHARD VON MISES, lecturer in the Graduate School of Engineering of Harvard University, has been appointed Gordon McKay professor of aerodynamics and applied mathematics, effective on July 1.

ASSOCIATE PROFESSOR A. C. BENJAMIN, of the department of philosophy of the University of Chicago, has been appointed John H. Lathrop professor of philosophy and chairman of the department of philosophy at the University of Missouri. Dr. A. B. Griffen, now of the University of Texas, has been appointed associate professor of zoology.

PROFESSOR ROBERT K. SUMMERBELL has been made chairman of the department of chemistry of Northwestern University. He succeeds Professor Ward V. Evans, who retires in September.

DR. PAUL G. ROOFE, assistant professor of anatomy at the School of Medicine of the University of Louisville, has been appointed professor of anatomy and chairman of the department of anatomy of the School of Medicine of the University of Kansas.

DR. ERIC BALLIOL MOULLIN, of King's and Downing Colleges, fellow of Magdalen College, and Donald Pollock reader in engineering science in the University of Oxford, has been elected into the newly established professorship of electrical engineering at the University of Cambridge from October 1.

DR. H. A. KREBS has been appointed to the newly established chair of biochemistry of the University of Sheffield, Yorkshire.

DR. MARCEL SCHEIN, of the department of physics of the University of Chicago, known for his work on cosmic rays, has been engaged as a consulting physicist by the Research Laboratory of the General Electric Company. He is working on problems connected with the radiations of the 100-million-volt induction electron accelerator; Alfred J. Hartzler, formerly of the department of physics of the University of Chicago, has become a member of the staff, for studies of the radiations produced by the 100-million-volt induction accelerator; Dr. Arthur M. Ross, Jr., until recently of Columbia University, has rejoined the chemical section. Dr. Ross was a member of the Research Laboratory in 1939-40, and later of the staff of the Works Laboratory in Bridgeport.

DR. RALPH E. CLELAND, head of the department of botany and bacteriology of Indiana University, spoke on May 21 before the Plant Institute of the Ohio State University on "The Contribution of Cell Studies in Oenothera to an Understanding of Hereditary Variation in the Genus." On this occasion a dinner honoring Dr. Cleland was held at the Faculty Club, after which he led a discussion on the adequacy of gene and chromosome mutation to account for evolution.

DR. VALY MENKIN, assistant professor of pathology at the School of Medicine of Duke University, delivered on May 15 the annual lectureship of the Sigma Zeta Society before the Medical College of Virginia. His subject was "Chemical Factors and their Rôle in Inflammation."

A CONFERENCE called by the Chinese Health Institute was held from March 5 to 11, with the object of coordinating research on nutrition in China. The subjects and speakers were as follows: Analyses of Chinese Food, Dr. Chi-Yuan Chow; Chinese Army Nutrition, Dr. Shing Wan; Special Requirements in Chinese Nutrition, Dr. Rose Yeh; Vitamin Research in China, Dr. Cheng-Fa Wang; Protein Nutrition Research in China, Dr. Teng-Yi Lo; Dietary Survey in China, Dr. Tung Shen; Nutritional Diseases in China, Dr. Shou-Kai Chow; Nutritional Requirements of the Chinese, Dr. Pei-Sung Tang; Nutritional Education and Extension Work in China, Dr. Sophie Chen; Evaluation of Methods Used in Nutrition Studies, Dr. C. Cheng; Adoption of Terminology for Nutrition Work, Dr. Pao-Chung Loo, and Processing of Chinese Foods and Food Value, Dr. Chao-Yü Chen.

DR. VICTOR A. TIEDJENS has resigned his position as associate olericulturist and associate professor of vegetable crops at Rutgers University to become

director of the Virginia Truck Experiment Station at Norfolk. He will take up his new work on July 1.

DR. J. BROOKES KNIGHT, lecturer and curator of paleozoic invertebrates in the department of geology of Princeton University, has been appointed research associate in paleontology at the Smithsonian Institution.

He will work at the U. S. National Museum beginning on July 1.

DR. DAVID F. SMITH, director of research of Johnson and Johnson, New Brunswick, N. J., has been elected a member of the board of directors of the company.

DISCUSSION

HEPATIC "INACTIVATION" OF ESTROGENS

LIPSCHÜTZ *et al.*¹ recently presented data purporting to indicate "that the liver is able to inactivate great quantities of estriol and equilin." This conclusion was reached on the basis of the relatively poor "fibrous tumoral effect" of these agents when implanted in the spleen of guinea pigs as compared with subcutaneous implantation.

We^{2,3} have shown that large amounts of endogenous and exogenous estrogen are excreted in the bile of dogs and human subjects; the rapid disappearance of exogenous estrogen from the systemic circulation and urine is due to this mechanism and not to its rapid destruction or inactivation by the liver. When a 15 mg pellet of alpha-estradiol was implanted in the spleen of a bile-fistula dog, estrogen was excreted in the bile in large amounts for at least 23 days, although no estrogenic activity could be demonstrated in the urine at any time during this period.³ This is conclusive evidence that with splenic implantation the absence of any type of effect dependent upon the presence of estrogen in the systemic circulation can not be interpreted as indicating its rapid destruction by the liver.

There can be no doubt that the liver is capable of inactivating estrogens *in vitro*, but that it does so rapidly *in vivo* is highly questionable. The results of all experiments on which this hypothesis is based prove only that the normal liver prevents estrogens from entering the systemic circulation in effective concentration. This could be accomplished by biliary excretion and subsequent enterohepatic circulation (as is the case with bile acids) as well as by rapid destruction in the liver. The latter hypothesis not only lacks incontrovertible proof but is indeed directly contradicted by our findings.

A. CANTAROW
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PHILADELPHIA, PA.

¹ A. Lipschütz, C. Becker, R. F. Mello and A. Riesco, *SCIENCE*, 101: 410, 1945.

² A. Cantarow, A. E. Rakoff, K. E. Paschkis, L. P. Hansen and A. A. Walkling, *Endocrinology*, 31: 515, 1942.

³ A. Cantarow, A. E. Rakoff, K. E. Paschkis, L. P.

A POSSIBLE CASE OF FICTITIOUS CONTINENTAL DRIFT

ONE point has apparently been overlooked in connection with early determinations of longitude cited as observational evidence in connection with the Wegener hypothesis of continental drift.¹ These earlier longitudes were determined from occultations of stars by the moon. The point is not the relatively low degree of accuracy attainable by this method; that point is conceded by all. The point is that longitudes determined from occultations are essentially different in character from longitudes determined by the observation of local times and the exchange of telegraphic or radio time signals.

An ordinary difference of longitude obtained from the exchange of time signals necessarily depends on the directions of the plumb lines at the two points involved. Ultimately we get back to the plumb line at Greenwich. The plumb line at either point may be deflected from what may be conceived as its normal direction. The deflection is due to the visible irregularities in the conformation of the earth's surface and to the invisible irregularities in the densities of the surrounding portions of the earth's crust.

On the other hand, if we examine the underlying equations used to determine longitudes from occultations, we shall find that the longitudes—and the latitudes also—implied in these equations depend not at all upon the direction of the plumb line but depend solely upon position with respect to the center and axis of the earth. They are latitudes and longitudes such as the geodesist would very much like to know, latitudes and longitudes freed from the effect of the irregular deflections of the plumb line. These latitudes and longitudes might be appropriately termed "ideal geodetic" latitudes and longitudes.

Why this should be so is easily seen. It is convenient to follow the course of an occultation or of a solar eclipse by thinking of the apparent sweep of the moon's shadow across the face of the earth as

Hansen and A. A. Walkling, *Proc. Soc. Exp. Biol. and Med.*, 52: 256, 1943.

¹ A. Wegener. *Die Entstehung der Kontinente und Ozeane*. 4th ed., 1929, Chap. 3; C. R. Longwell, *SCIENCE*, 100: 403-404, 1944.

the moon moves in its orbit (the sun also, if an eclipse is considered) and as the earth rotates on its axis. For a given place an eclipse begins or ends at the instant of (Greenwich) time when the exact edge of the shadow reaches the place. For a given place this (Greenwich) instant time will be determined by the position of the place with reference to the body of the earth, that is, by its ideal geodetic latitude and longitude—also by its radial distance from the earth's center—and not at all by the direction that the plumb line at that place may happen to take. The direction of the plumb line might vary widely and wildly from the normal without affecting the times of the various phases of the eclipse or occultation. The direction of the plumb line would, of course, affect the local time and hence the inferred longitude, but the equations for determining the longitude from an eclipse assume that the ideal geodetic longitude and the actual longitude affected by a deflection are identical.

The geodesist may be able on the basis of extensive and careful surveys to obtain approximations to these ideal geodetic latitudes and longitudes. But his results are based on studies of limited regions, of a continent at most, not on surveys of all the continents and of all the oceans, such as would be necessary to get really accurate values of ideal geodetic latitudes and longitudes.

How large are the differences between the astronomer's ordinary latitudes and longitudes, which depend on the direction of the plumb line, and the geodesist's latitudes and longitudes, from which the effects of the irregular deflections of the plumb line have been at least partially eliminated and which are thus approximations to ideal geodetic latitudes and longitudes? These differences are commonly known as deflections of the plumb line. Deflections of 5" are commonplace, of 10" are common enough; deflections of 20" are not rare and even larger deflections are sometimes found in mountainous country and on oceanic islands. One second of arc corresponds to about 100 feet in meridional distance on the surface of the earth; one second of deflection in longitude corresponds in latitude 45° to 72 feet measured perpendicular to the meridian. By confounding the two kinds of latitude and longitude we may thus make errors in location of many hundreds of feet.

An argument in favor of the Wegener theory based on a comparison of differences of ideal geodetic longitude derived from lunar occultations—and supposed accurate—with differences of ordinary astronomical longitude derived from exchanges of time signals would therefore be fallacious. The two kinds of longitude are different and a fictitious continental drift of hundreds of feet may be apparently "proved," if the two kinds are confounded.

This discussion has, of course, no bearing on a comparison of earlier differences of longitude with later determinations, both determinations being based on time signals.

WALTER D. LAMBERT

U. S. COAST AND GEODETIC SURVEY

FOSSIL DISCOVERY NEAR SAN FRANCISCO

A FOSSIL deposit recently discovered near San Francisco Bay in California has been found to contain, all in close relationship, elephant bones, the tooth of a prehistoric horse, insect remains and a wide variety of botanical specimens.

The location of the discovery is in the unincorporated village of Millbrae, south of San Francisco, on the peninsula that separates the bay from the ocean. The bay at this point is skirted by a wide strip of former salt marsh which has been drained and used for farming and pasture. The fossil deposit was found under one of a series of low hills that protrude into the edge of the former salt marsh, about three fourths of a mile from the shore of the bay on one side, and about the same distance from the foot of larger hills on the other.

To the west, forming the backbone of the peninsula, is a range of hills that reach an altitude of 1,200 feet. The hill at the edge of the salt marsh, which at the point of the discovery attained an elevation of about 20 feet above sea level, was being cut down and leveled off for a housing project when, about 12 feet under the former hill top, the grading machinery cut through the stump of a tree and an elephant's tusk. A careful investigation of the area was immediately undertaken, and excavation of the fossils has now been completed.

Ten elephant tusks were found, but the bones, teeth and tusks, while generally grouped in positions according to size, thus seeming to indicate where the bodies had originally lain, were not articulated in the form of skeletons, nor were all the parts of any one skeleton found.

The largest tusk was approximately ten feet in length and eight inches in maximum diameter, while the smallest was only about four feet long. The largest tusks were sharply curved in two dimensions, while the smaller ones tended to be more nearly straight.

Because of the advanced state of decay in which the fossils were found, it was only with great care and the use of plaster casts that any of the tusks or bones were preserved. Tusks that appeared to be sound shattered into small bits at the first attempt to move them, and the bones were usually more fragile than the matrix that surrounded them. Portions of bones were partially mineralized, while other portions, sometimes of the same bone, had completely disap-

peared—apparently through decay, but possibly in some cases from having been eaten by carnivores. Decay was too far advanced, however, to be sure of any evidence of the latter, such as teeth marks.

From their positions, the bones would seem to have been scattered and maltreated for some time before being covered, but they were also distorted afterward by movements of the earth. These distortions varied from a slight fracture or curvature to an indistinguishable mass of bones pressed together as if by a landslide.

Twenty-one more or less complete teeth were obtained, five of which are still *in situ* in the jaw bones. There are, besides, many fragments and portions of teeth. No cranium was found, scarcely even a recognizable portion, and almost no vertebrae. On the other hand, the mandibles of two animals are nearly complete, and one other pair, the largest, was found complete but grotesquely distorted and badly decayed. Other readily recognizable bones were a femur and various other leg bones, scapulae, pelvic bones and ribs.

A superficial study of the teeth tentatively identifies the animals as belonging to the Columbian species (*Parelephas Columbi* Osborn).

The geological structure of the region suggests that the fossils were deposited in the marginal area of an alluvial fan. The most careful geological study of the area was made by Professor Eliot Blackwelder, of Stanford University, whose findings are herewith quoted. No dissenting opinions have been advanced by any of several other geologists who visited the excavations.

There are strata that show "the usual varieties of sedimentary material," says Blackwelder, "characteristic of alluvial fans in this part of California." They comprise fairly clean gravel and various grades of sand, all distinctly although complexly stratified. There are also beds of very poorly sorted pebbly material which is probably the result of successive mudflows. All these are stream channel deposits, indicating many temporary channels spaced only a few feet apart.

The deposit in which the elephant bones were found was a uniform bed of "smoke-gray" sand mixed with clay, which was probably an overflow out beyond the stream channels. Blackwelder's analysis of this bed is as follows: "course gray sand about 58 per cent., fine sand about 17 per cent., dark gray silt with a minor amount of coarse clay about 25 per cent." It owes its dark color to "much finely comminuted woody material."

The horse tooth (equus) mentioned at the beginning of this article was found in gravel at the edge of a stream bed. It was within a few feet of some

of the elephant bones but not in the same sedimentary deposit. The elephant bones, on the other hand, were almost without exception in the bed of gray sand-clay described above, all within an area about 15 by 40 feet, and with not over 8 feet variation in depth.

As to the age of this deposit, consensus of opinion places it in middle or late Pleistocene time. Blackwelder has summarized the data as follows:

From the undisturbed character of the beds and the unmineralized condition of both wood and bones, I infer that they are not older than Middle Pleistocene. On the other hand, the extent to which the original fan has been eroded, the altered condition of the wood, and the progress of decay in the more susceptible pebbles in the gravel indicate that they are not of Recent age and probably do not belong to the latest part of the Pleistocene. . . . I am inclined to venture the guess that the alluvial fan at Millbrae dates from about the time of the third or Tahoe glacial epoch or else the immediately preceding or succeeding interglacial age.

Summing up the data, the forming of this deposit of elephant bones may well have occurred in the following manner. During the process of formation of this alluvial fan, much of its surface was probably covered with vegetation on which elephants might feed. Furthermore, during rainy seasons this bed of sand-clay could well be soft enough so that animals as heavy as elephants would sink in it and not be able to escape. After they had been entrapped and died, their carcasses would be eaten by carnivores and their bones exposed, scattered and trampled probably for some time before being covered by the expanding alluvium.

When once they were covered, the fineness of the mudflow around them, together with the never-failing supply of ground water at this low level, created an anaerobic condition which preserved them from complete decay. The distortion of the bones could well be caused by slumps or crawling of the soil, or possibly by earthquake action. It should be added that in all the excavation there was no evidence of marine life.

The botanical and insect specimens were found both in conjunction with the elephant bones and also over a wider area. Some were in immediate juxtaposition with the bones, and all were in the same surrounding alluvial deposit. They ranged from small seeds and finely comminuted wood particles up to stumps and sizable logs, and from a lone blue iridescent beetle wing to whole insects. None of the trees were *in situ*, evidently having been washed down from the hills, but many of the smaller plants may well have grown on the surface of the expanding alluvial fan.

F. D. Klyver, paleobotanist at San Mateo Junior

College, has identified sixty-eight different varieties of plants, and the study is by no means completed. Not counted in this number are many specimens of wood and bark, some microscopic, others several feet long.

Heading the list of trees so far identified are Douglas fir, Monterey pine, Monterey cypress and Alder. Manzanita, snow berry and poison oak are among the shrub species, and yerba buena and wild blackberry are two species of vines present. The list of smaller plants, representing the common wildflowers such as red maids and miner's lettuce, include grasses, sedges and rushes. One fossil bulb has been found. Added to all these items is one equisetum (scouring rush or horsetail), and one or more mosses. There are also more than twenty-five specimens of

insects and closely related animals. The green, scarab-like iridescence of a beetle's wing was the first evidence of prehistoric insects to be discovered. The collection now includes several kinds of beetles, ants, grasshoppers and one or more millipeds. Numerous specimens of what appear to be insect and spider eggs have been found.

It is impossible at present to say of what value this fossil discovery may prove to be, nor which part of it may be of greatest significance. It does at least afford an opportunity for an authentic reproduction of a period of prehistoric life in this area. The specimens are still under study at San Mateo Junior College, San Mateo, California.

FRANK M. STANGER

SCIENTIFIC BOOKS

ARGASIDAE

The Argasidae of North America, Central America and Cuba. By R. A. COOLEY and GLEN M. KOHLS. iii + 152 pp. 57 figures. 14 plates. (The American Midland Naturalist Monograph No. 1.) Notre Dame, Ind.: The University Press. 1944.

THIS monograph is the third in a series of monographs of the ticks of North America. The first, appearing in 1938, monographed the genera *Dermacentor* and *Octocentor*; the second, in February, 1944, treated the genus *Amblyomma*; the present one is more ambitious and treats of the family Argasidae not only of North America but includes Central America and Cuba. This beautiful volume is not only well illustrated but contains a wealth of information about the soft ticks of the region under discussion. Like the preceding numbers it is a model of exactness and clarity. As certain species are important vectors of diseases this work will prove of great value not only to the taxonomists but also to the medical and veterinary profession.

The authors first present a general account of the family, followed by a detailed explanation of the various terms used in the text. A brief account of methods of handling, studying and rearing ticks is also given, and the reviewer wishes this could have been more detailed and illustrated. There is also a brief statement of the medical and veterinary importance of the Argasidae. The authors point out that at least five species of *Ornithodoros* (*hermsi*, *turicata*, *parkeri*, *talaje* and *rudis*) are proved vectors of relapsing fever spirochaetes; one species (*O. parkeri*) has been proved experimentally to be a vector of Rocky Mountain spotted fever and American Q fever. *Argas persicus*, of world-wide distribution in warm climates, is a notorious pest of poultry and is the vector of avian spirochaetosis and is also reported

as a probable vector of fowl paralysis. Other species are important pests of various animals, including man.

The main part of the volume is devoted to a detailed account, with numerous illustrations, of the various species. The authors recognize four genera and twenty-four species in the restricted area. These are *Argas*, with two species; *Octobius*, with two species; *Ornithodoros*, with 18 species; and *Antricola*, with two species. In general the following information is given for each species: a list of synonyms; detailed description of the adult; brief descriptions of the larval and nymphal stages when known; line drawings of significant details; photographs of dorsal and ventral views of many of them; host data; biological notes; distribution records with spot maps. Closely related species are treated in great detail and the important differences between them stressed. Keys to genera and species are provided.

The monograph concludes with a classified list of hosts and their ticks; a geographical distribution summary and an excellent bibliography. This volume will prove of great value to the parasitologists and medical entomologists; the members of the medical and veterinary professions will also find much in it that is of importance to them.

ROBERT MATHESON

THEORY OF FUNCTIONS

The Theory of Functions. By J. E. LITTLEWOOD. 243 pp., Oxford University Press. \$5.50.

A BOOK by the noted English mathematician, J. E. Littlewood, is sure to arouse widespread interest. The present volume, two thirds of which was printed in 1931, deals largely with conformal mapping, harmonic and subharmonic functions of two real variables,

"Picard" and schlicht functions and other related topics.

It is written for the research worker in complex variable theory. Emphasis is placed on "best possible" results, on the comparison between alternative methods of proof, on establishing "existence theorems" with a maximum of generality and on precise inequalities. Informal comments such as "this theorem is

difficult (and the reader may ignore it if he wishes)" enliven the reading. Though the non-specialist will find the standard treatises of Titchmarsh and Copson sufficiently detailed and perhaps better balanced, the specialist will want Professor Littlewood's book for the intimate and critical perspective which it gives into the structure of complex variable theory.

GARRETT BIRKHOFF

SPECIAL ARTICLES

GLUCURONIC ACID AS A MEASURE OF THE ABSORPTION OF PENICILLIN

THE coupling of such compounds as resist the oxidative processes of the body, with normal metabolic compounds, constitute a primary defense mechanism. The animal organism utilizes a variety of substances for conjugation, principally glycine, glucuronic acid, sulfuric acid, cysteine, glutamine, acetic acid, ornithine and the methyl group. The main source of glucuronic acid is the carbohydrate store in the body, but it can also be derived from glucogenetic amino acids.^{1, 2}

That organic compounds can be conjugated in the mammalian body is a fact first recognized by Baumann.³ Since his early recognition of this fact, it has since been demonstrated by Deichmann *et al.*⁴ that many other compounds undergo conjugation in this manner.

Enklewitz⁵ demonstrated that the reducing substance found in the urine after the ingestion of amidopyrine is a conjugated glucuronic acid complex. Tsunoo⁶ did extensive work with ethynal and found that the body hydrolyzes it to furylaerylic acid, which it conjugated with glycine, and p-hydroxy-phenylurea, which it combines with glucuronic acid. Horn⁷ reported that dimethylalanine in the rabbit is converted to p(mono)-methylamino-phenol and is excreted in combination with glucuronic acid. In dogs, Horn found that the same compound is changed to o-amino-phenol.

In view of these reported findings this investigation was undertaken to determine whether a similar conjugation takes place between penicillin and glucuronic acid and if so whether the glucuronic acid determination in urine may be used as a measure of

the absorption of penicillin. It was further hoped this study would offer additional information in determining the mode of action of penicillin.

EXPERIMENTAL

Male New Zealand rabbits were employed weighing approximately 2,400 to 3,200 grams. They were maintained on a diet consisting chiefly of a standard dry commercial feed (Purina rabbit pellets) and small daily portions of fresh carrots and cabbage. The treated animals received intravenous doses of penicillin sodium varying from 50,000 to 200,000 Oxford units (300 μ /mg penicillin salt) and were placed in metabolism cages for the collection of urine. The cages were designed to avoid the contamination of feces with the excreted urine. Urine was collected for control over 24-hour periods for one week prior to treatment. Glucuronic acid and organic sulfate determinations were made daily.

Fig. 1 demonstrates the influence of penicillin on

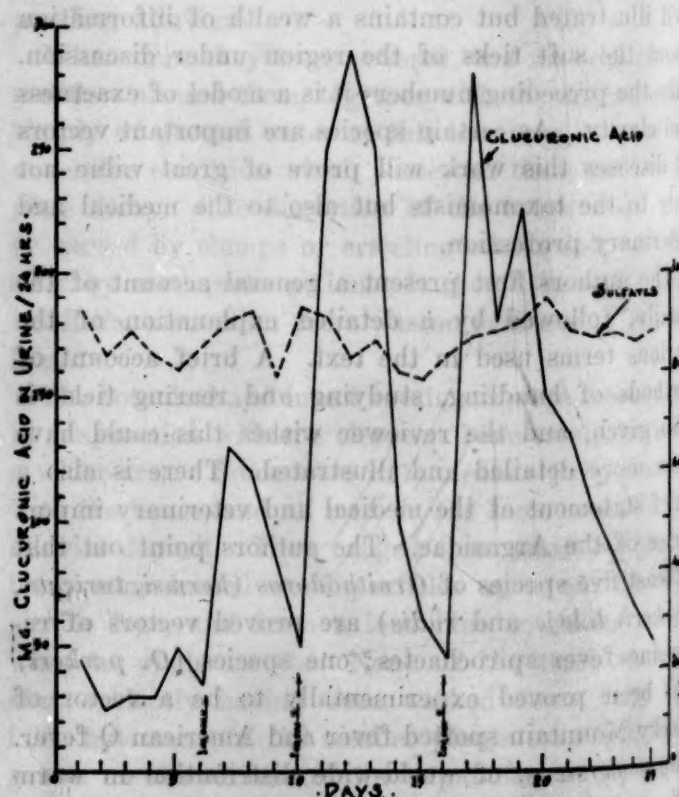


FIG. 1. Effect of penicillin on the excretion of glucuronic acid and inorganic sulfates in the urine.

¹ Anthony Ambrose and Carl P. Sherwin, "Detoxication Mechanisms," Vol. 2, p. 377, 1933.

² Benjamin Harrow and Carl P. Sherwin, "Detoxication Mechanisms," Vol. 4, p. 263, 1935.

³ E. Baumann, "Weber Geparate Schwefelsauren im Organismus," *Arch. f. d. ges. Physiologie*, 13: 285, 1876.

⁴ Wm. Deichmann and G. Thomas, *Jour. of Ind. Hygiene and Toxicology*, 25: 286, 1943.

⁵ M. Enklewitz and M. Lasker, *Jour. Biol. Chem.*, 110: 443-56, 1935.

⁶ S. Tsunoo, *Jour. Biochem. (Japan)*, 21: 409-16, 1935.

⁷ F. Horn, *Z. f. Physiol. Chem.*, 242: 23-28, 1936.

the glucuronic acid content in urine in a typical animal experiment. The time of penicillin treatment is indicated. A twenty-five-day test period was used.

The glucuronic acid of the untreated animals was found to be within the normal range for rabbits, as set forth by Deichmann.⁸ However, 24 hours after penicillin treatment, a marked increase in glucuronic acid was quantitatively demonstrable by the methods of both Deichmann⁸ and Hanson.⁹

Analyses for solids, specific gravity, pH, sugar and albumin were also daily made, but since there was no significance in the data they are not recorded.

For the purpose of comparison, the excretion of penicillin as organic sulfates was also determined and the results recorded as per cent. of inorganic to total sulfates. The method of Treon and Crutchfield¹⁰ was used for these determinations. Since there was no definite trend in the values obtained other than normal variation, it is concluded that penicillin does not influence the *in vivo* excretion of sulfates.

RESULTS

The normal 24-hour excretion of glucuronic acid in rabbit urine maintained on a diet of Purina rabbit chow, fresh carrots and cabbage ranges from 25 to 60 mg.

Following treatment of rabbits with penicillin sodium, a marked increase in glucuronic acid was noted. The treated animals gradually returned to normal.

Tests were made to determine whether or not penicillin sodium itself gives a color reaction characteristic of the naptha-resorcinol-glucuronic acid method of both Deichmann⁸ and Hanson.⁹ The results of the investigation in both instances were negative.

DISCUSSION

It is the general opinion of most investigators that approximately 60 per cent.¹¹ of penicillin administered can be recovered from the excreted animal urine. Since in this investigation it was found that there was an immediate sharp increase in the glucuronic acid content of rabbit urine following the intravenous administration of penicillin, it would appear likely that some part of the unaccounted-for 40 per cent. of penicillin normally excreted from the animal body conjugated with glucuronic acid.⁴

⁸ Wm. Deichmann, *Jour. Lab. and Clin. Med.*, 28: 770, 1943.

⁹ S. W. Hanson, G. T. Funch Mills and R. T. Williams, *Biochem. Jour. England*, 38: 3, 274, 1944.

¹⁰ Treon and Wm. Crutchfield, Jr., *Ind. Eng. Chem., Anal. Ed.*, 14: 119, 1942.

¹¹ C. K. Rammelkamp and C. S. Keefer, *Jour. Clin. Invest.*, 22: 425, 1943.

The data suggest the possibility of using the quantitative determination of glucuronic acid in urine to detect the presence and the extent of absorption of penicillin.

It is further possible that, since commercial penicillin contains certain impurities, the increased glucuronic acid in urine may be due to the impurities of penicillin rather than penicillin itself. The experiments will be extended with more highly purified penicillin.

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NON-ACID-FAST FORMS OF THE MYCOBACTERIUM OF HUMAN LEPROSY*

IN 1939, the writer had the opportunity of staining several smears of material obtained at the Branch Laboratory of the New York State Department of Health from the nasal septum of a Mexican who had been diagnosed as an early case of leprosy.¹ The smears were stained by the author's Triple Stain method² which reveals non-acid-fast forms of *Mycobacterium tuberculosis* not disclosed by the usual Ziehl-Neelsen technic. When this method is applied to material from tuberculous lesions or cultures, acid-fast tubercle bacilli stain red, non-acid-fast forms (rods, granules, and the recently demonstrated zooglyphic forms)³ stain blue, while other organisms, tissue cells, etc., form a light green background.

The two leprosy smears stained in this manner showed acid-fast rods, and a few non-acid-fast forms. As soon as the patient became aware of the diagnosis of his affliction, he made an escape from supervision, and no further material could be obtained.

Recently, however, Dr. Frank Combes, professor of dermatology at New York University and chief of the Dermatology Service at Bellevue Hospital, suggested that material from cases of leprosy might reveal interesting non-acid-fast forms if stained by the author's Triple Stain technic. He kindly arranged to have a number of unstained fixed smears of nasal

* This work was supported by a grant from the Lessing J. Rosenwald Foundation.

¹ Dr. Morton C. Kahn informs me that in 1929 he visited Mahaika Leprosarium in British Guiana after completing his studies on the development of the tubercle bacillus, as he felt that non-acid-fast forms might be concerned in the pathology of leprosy. The finding of so many non-acid-fast saprophytes in the nasal cavity caused the work to be discontinued, and there was insufficient time for skin biopsies.

² E. Alexander-Jackson, *SCIENCE*, 99: 307, 1944.

³ E. Alexander-Jackson, *Annals of the New York Academy of Sciences* (in press).

material sent to the writer from a case of leprosy at the Willard Parker Hospital. These smears were stained by the Triple Stain method and examined. They revealed not only red-staining acid-fast bacilli, but blue-staining non-acid-fast rods in even greater numbers. Some of the nests of rods were mixtures of the two types, but many nests consisted of blue-staining rods only.

Dr. Combes then secured from Dr. F. A. Johansen, Dr. G. H. Faget and Dr. G. L. Fite, of the U. S. Marine Hospital at Carville, La., a box of fixed unstained smears made from leprosy skin biopsies. Each preparation represented a different case. These were all stained by the writer's Triple Stain method and carefully examined. The results are given in Tables 1 and 2.

TABLE I
THIRTY-TWO LEPROSY SMEARS STAINED BY THE TRIPLE
STAIN TECHNIC*

Type lesion	Patient's number	Date of admission	Acid-fast		Non- acid-fast	
			Rods	Zoogles and granules	Rods	Zoogles and granules
Lepromatous	651	1929	0	0	+	+
	1530	1942	+	0	0	+
	1644	1944	0	+	+	+
Neural	118	1921	0	0	0	+
	653	1929	0	0	0	+
	1536	1942	0	0	0	+
Tuberculoid	1634	1944	0	0	0	+
	1679	1944	0	0	0	+
Maculo- Anesthetic	699	1930	+	0	+	+
	1651	1944	0	0	0	+
Mixed	859	1932	0	0	0	+
	884	1932	+	0	+	+
	941	1933	0	0	0	0
	1073	1935	0	?	0	?
	1150	1936	+	0	+	0
	1280	1938	+	0	+	+
	1332	1939	0	0	0	+
	1375	1940	0	0	0	+
	1377	1940	0	+	0	+
	1393	1940	0	0	0	+
	1509	1942	+	0	+	+
	1510	1942	0	0	0	+
	1511	1942	0	0	0	+
	1514	1942	0	0	0	+
	1552	1942	+	0	+	+
	1590	1943	0	0	0	+
	1604	1943	0	+	0	+
	1606	1943	+	+	+	+
	1617	1944	+	+	+	+
	1652	1944	0	0	0	+
Type not known	1354	1939	0	0	0	+
Nasal	Willard Parker	1944	+	+	0	0

* Only three smears showed presence of contaminating organisms.

Of the 32 cases, 27 smears (84.4 per cent.) showed zooglear and granule or spore-like forms; 16 smears (50 per cent.) showed zooglear forms only; 13 smears (40.6 per cent.) showed some acid-fast forms; 11

smears (34.4 per cent.) showed acid-fast or non-acid-fast rod forms. The findings are apparently unrelated to the dates of admission, as there was no greater tendency for smears from older cases to show greater numbers of rod forms. The stained preparation from the oldest case, admitted twenty-four years ago (1921), showed non-acid-fast zooglear forms only.

It was interesting to note the presence of zooglear forms and absence of rods in all the smears from the group of six neural and tuberculoid cases. Bacilli are usually lacking or difficult to demonstrate in these types of lesions.⁴

Occasionally, forms were found in which frankly acid-fast rods and granules lay within a blue-staining

TABLE II
ENUMERATION OF FINDINGS ON THIRTY SMEARS FROM SKIN
BIOPSIES TAKEN FROM LEPERS AT CARVILLE, LA.

Totals	Type lesion	Rods	Zooglear forms	Granules or spore- like bodies
3	Lepromatous	2	2	3
3	Neural	0	3	3
2	Tuberculoid	0	2	1
2	Maculo- Anesthetic	1	2	2
20	Mixed	7	16	5
30		10	25	14

zooglear mat. Some of the zooglear forms were acid-fast, and some were semi-acid-fast.

While relatively few cases are reported here, and *Mycobacterium leprae* can not as yet be cultured on suitable media or successfully inoculated into animals⁵ in order to obtain absolute experimental proof, nevertheless these findings strongly suggest that the mycobacterium of human leprosy, like the mycobacterium of tuberculosis, has a zooglear form or phase. The existence of non-acid-fast forms in leprosy may explain certain peculiarities in the course of the infection, such as its protracted incubation period, and the difficulty in demonstrating bacilli in certain types of lesions. The results of this limited study would seem to encourage more extensive observations with the aid of the Triple Stain technic.

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⁴ S. H. Black, "Tuberculosis and Leprosy, The Mycobacterial Diseases," edited by F. R. Moulton, Symposium Series Vol. I, American Association for the Advancement of Science, 97, 1938.

⁵ M. H. Soule and E. B. McKinley, *ibid.*, 87.

THE ACTIVITY OF A BACTERIOSTATIC SUBSTANCE IN THE REACTION BETWEEN BACTERIAL VIRUS AND HOST¹

Most bacteriostatic agents are supposed to act in suppressing growth by interfering with the metabolism of an essential substance either by combining with it

phane at concentrations about 1/1000th those of the *dl*-Bz-3-methyltryptophane. It thus appears probable that the methyltryptophane interferes in some manner with either the synthesis or utilization of tryptophane by *E. coli* grown on ammonium lactate medium.

The Effect of Bz-3-methyltryptophane on the Activity of Bacterial Viruses. The strain B of *E. coli* used

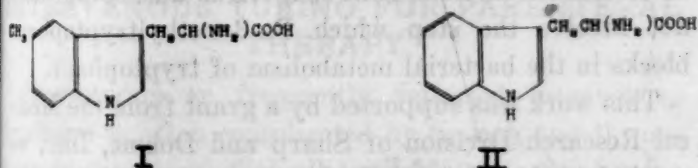
TABLE 1
GROWTH OF *E. coli* IN AMMONIUM LACTATE MEDIUM CONTAINING MIXTURES OF *l*-TRYPTOPHANE AND *dl*-Bz-3-METHYLTRYPTOPHANE

<i>l</i> -tryptophane (micromoles/ liter)	Bz-3-methyltryptophane (micromoles/liter)					Bz-3-methyltryptophane (micromoles/liter)					Bz-3-methyltryptophane (micromoles/liter)				
	460	92	18	3.7	0	460	92	18	3.7	0	460	90	18	3.7	0
	Growth after 22 hours					Growth after 43 hours					Growth after 3 days				
2	2	2	2	2	2	4	4	4	4	5	4	5	4	4	6
0.4	2	2	2	2	2	2	4	3	3	5	4	5	4	4	6
0.08	0	1	1	1	2	0	1	3	3	5	1	4	4	4	6
0.016	0	1	1	1	2	0	1	3	3	4	1	3	4	4	4
0.0032	0	0	0	0	2	1	0	0	1	4	1	2	1	4	5
0	0	0	0	0	2	0	0	0	2	4	2	0	0	3	4

Initial inoculum 10^6 bacteria to 1 cc ammonium lactate medium in each tube.
0 = no visible growth, 1 = trace, . . . , 6 = heavy growth.

chemically,² or by competing with it for positions on enzyme surfaces by virtue of the structural similarity of the agent to that of the essential metabolite (see reference 3 for literature references).

The results of the present work appear to bear on this point. It is found that while Bz-3-methyltryptophane (I) suppresses the growth of *B. coli* strain B in the absence of added tryptophane and does not do so in the presence of traces of tryptophane (II), it



appears to act as tryptophane does⁴ in promoting the action of the bacterial viruses T4 and T6 on this strain of *E. coli*.

The Bacteriostatic Action of Bz-3-methyltryptophane and Its Reversal by Tryptophane. Preliminary experiments showed that Bz-3-methyltryptophane inhibited the growth of *E. coli* on solid or liquid ammonium lactate medium,⁵ but that it did not do so on Difco nutrient agar. Such inhibition was observable at concentrations of *dl*-Bz-3-methyltryptophane as low as 4 micromoles/liter and, as seen in Table 1, was reversed at this and higher concentrations by *l*-trypto-

in the above experiments is susceptible to the action of three bacteriophages, T2, T4 and T6⁶ which belong to the same serological group and have similar morphologies.⁷ T2 is rapidly absorbed on B in the ammonium lactate medium, while T4 and T6 are very slowly adsorbed in the medium unless *l*-tryptophane at 50 micromoles/liter or some other co-factor (phenylalanine is weakly active) is present in the adsorption mixture.⁴ This reaction seemed to be quite specific, for none of a long list of other amino acids, growth substances or known precursors of tryptophane proved to be capable of acting as co-factors for T4.

Turning to the study of a series of substances chemically related to tryptophane, Bz-3-methyltryptophane appeared to be highly active in promoting the adsorption of T4 on B. In experiments patterned after those described elsewhere⁴ it was found that in 5 minutes Bz-3-methyltryptophane at a concentration of 200 micromoles/liter brought about the adsorption of about 50 per cent. of the particles in a mixture of T4 and B in the ammonium lactate medium, while the adsorption in controls without a co-factor was negligible. Moreover, virus particles so adsorbed went on to the production of plaques on a bacterial smear just as though the co-factor had been *l*-tryptophane.

A convenient method for comparing the activities of various co-factors is provided by the lytic reaction of

¹ From the Eldridge Reeves Johnson Research Foundation, University of Pennsylvania, Philadelphia.

² Fildes, *Brit. Jour. Exp. Path.*, 21: 67, 1940.

³ D. W. Woolley, *Science*, 100: 579, 1944.

⁴ T. F. Anderson, *Jour. Cell. and Comp. Physiol.*, 25: 17, 1945.

⁵ T. F. Anderson, *ibid.*, 25: 1, 1945.

⁶ M. Demerec and U. Fano, *Genetics*, 30: 119, 1945.

⁷ T. F. Anderson, M. Delbrück and M. Demerec, "Types of Morphology Found in Bacterial Viruses." Paper given at the second annual meeting of the Electron Microscope Society of America, Chicago, on November 17, 1944.

certain virus suspensions on host cells which have been heavily irradiated with ultraviolet light. Not requiring a co-factor, T2 virus rapidly lyses *E. coli* B irradiated with some 200 to 500 lethal doses of ultraviolet light. Such lysis proceeded in a summary manner, *i.e.*, without the multiplication of virus which accompanies lysis of normal host cells. In the case of T2 virus, this reaction is accomplished by a lytic substance which is separable from the major portion of the virus particles.⁵

T4 and T6 virus display no such activity in the absence of a suitable co-factor to enhance their rates of adsorption on the host cells; with a co-factor present, T4 and T6 each react in a manner related to the concentration and activity of the co-factor. The results of a comparison of the activities of *dl*-tryptophane and *dl*-Bz-2-methyltryptophane are given in Fig. 1. It is

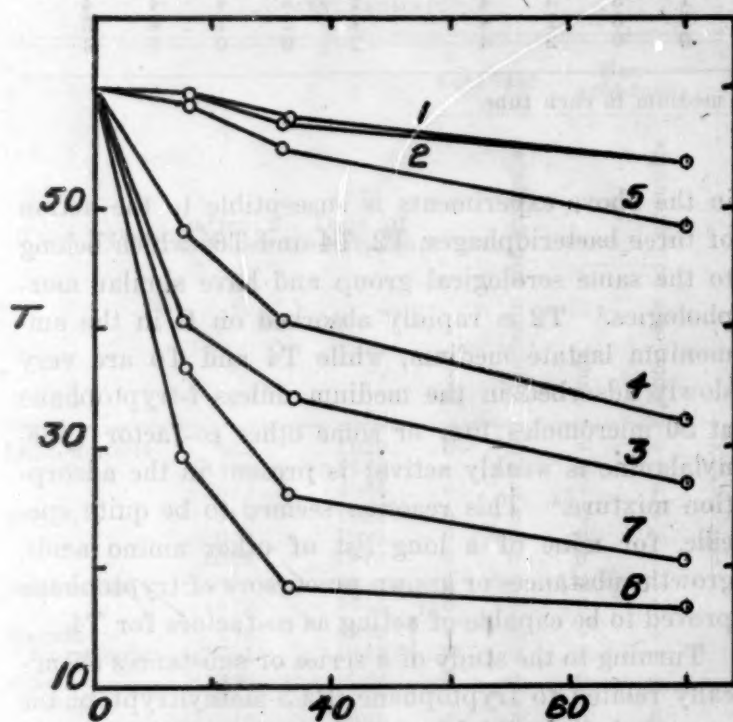


FIG. 1. The lysis of UV-irradiated *E. coli* strain B by viruses T4 and T6 in the presence of co-factors *dl*-tryptophane and *dl*-Bz-3-methyltryptophane. The bacteria in an actively multiplying state in ammonium lactate medium were irradiated in a quartz tube with about 500 lethal doses of ultraviolet light from a H-4 lamp with the outer glass shell removed. 5 cc of the irradiated bacterial suspension were then added to each of seven colorimeter tubes which contained in 0.4 cc of the ammonium lactate medium: 1. Control. 2. 0.95×10^{10} T4 virus particles. 3. 0.95×10^{10} T4 virus particles + 0.204 mg *dl*-tryptophane. 4. 0.95×10^{10} T4 virus particles + 0.201 mg *dl*-Bz-3-methyltryptophane. 5. 0.90×10^{10} T6 virus particles. 6. 0.90×10^{10} T6 virus particles + 0.204 mg *dl*-tryptophane. 7. 0.90×10^{10} T6 virus particles + 0.201 mg *dl*-Bz-3-methyltryptophane. The turbidities of tubes were read at intervals on a Klett-Summerson Colorimeter (blue filter No. 42) and in the figure are plotted as ordinates against minutes after mixing plotted as abscissae.

seen that the methyltryptophane at 170 micromoles/liter is only slightly less active than *dl*-tryptophane itself at 185 micromoles/liter. These experiments show that Bz-3-methyltryptophane can take the place

of tryptophane in the adsorption reaction between the viruses T4 and T6 and their host.

Discussion. Gordon and Jackson⁸ showed that Bz-3-methyltryptophane can not replace tryptophane in the diet of the rat. Indeed, the death of three out of four animals fed diets in which Bz-3-methyltryptophane replaced tryptophane suggested to them that the compound might be somewhat toxic. However, in further work they found that the substance had no effect on the growth rate of rats fed an adequate diet. The above experiments on the reversal of the methyltryptophane inhibition of *E. coli* growth by traces of tryptophane suggest that the tryptophane in Gordon and Jackson's complete diet for rats may have masked the detrimental effects of Bz-3-methyltryptophane.

The fact that Bz-3-methyltryptophane has almost the activity of tryptophane as a co-factor for T4 and T6 adsorption on their hosts is interesting from a number of standpoints. It indicates that this inhibitor of bacterial growth actually does perform the function of the structurally similar essential metabolite, tryptophane, in the reaction between the viruses T4 and T6 and their host. As to the function of the co-factor, it is not yet clear whether, as a cement substance, it acts in the specific combination between virus and host receptive spots or whether it acts as a sort of coenzyme in whose presence the virus particles, during their chance encounters with the host cells, are able to become attached to them and begin their parasitic activity. The high efficiency of Bz-3-methyltryptophane as a co-factor for the virus would suggest that the chain of essential reactions following virus adsorption does not involve the step which Bz-3-methyltryptophane blocks in the bacterial metabolism of tryptophane.

This work was supported by a grant from the Medical Research Division of Sharp and Dohme, Inc.; we are indebted to Drs. W. G. Gordon and R. W. Jackson, of the Eastern Regional Laboratory, U. S. Department of Agriculture, for the Bz-3-methyltryptophane used in the experiments.

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THE LOCAL ANESTHETIC PROPERTIES OF ISONIPECAINE

WHILE investigating the actions of isonipecaine, 1-methyl-4-phenylpiperidine-4-carboxylic acid ethyl ester hydrochloride, it was noted that the compound produced pronounced corneal anesthesia when it was applied to the rabbit eye. Although isonipecaine has been reported^{1,2} to abolish the wink reflex, the effect was produced after systemic administration. The

⁸ W. G. Gordon and R. W. Jackson, *Jour. Biol. Chem.*, 110: 151, 1935.

¹ O. Schauman, *Arch. f. Exper. Path. u. Pharmacol.*, 196: 109, 1940.

² R. C. Batterman, *Arch. Int. Med.*, 71: 345, 1943.

action we obtained was essentially, a local one, and was not due to the central actions of isonipecaine.

Subsequent studies on the local anesthetic properties of isonipecaine revealed that it possesses considerable specificity for nervous tissue when applied locally. The drug was compared experimentally with an equal concentration of cocaine. The results of our preliminary studies are summarized in Table 1.

TABLE 1
LOCAL ANESTHETIC PROPERTIES OF ISONIPECAINE
COMPARED WITH COCAINE

Method (3)	Criterion	Drug	Minutes
Rabbit cornea	Duration of anesthesia	1 % cocaine	31
		1 % isonipecaine	19
Intradermal wheal in man	Duration of anesthesia	1 % cocaine	78
		1 % isonipecaine	57
Frog sciatic	Onset of sensory block	1 % cocaine	2.5
		1 % isonipecaine	2.6
	Onset of motor block	1 % cocaine	13
		1 % isonipecaine	17

The fact that isonipecaine exhibits local anesthetic properties suggests that the compound may possibly be used advantageously as a preanesthetic agent for chloroform or cyclopropane anesthesia, and for operations involving the heart. There have been several recent reports^{4, 5, 6} stating that the administration of certain local anesthetics depresses cardiac irritability.

Consequently this depression results in a lessened tendency for cardiac disturbances during chloroform⁷ or cyclopropane⁸ anesthesia, and during operations on or near the heart.^{4, 5} Isonipecaine may possibly act in the same manner. In fact, the information at hand on the cardiac effects of isonipecaine favors this conclusion. Like others^{1, 9} we have found that isonipecaine has a depressant action on the heart.

Also in the event of isonipecaine poisoning, it would seem logical to prevent or treat the overdosage with agents similar to those used in cases of local anesthetic toxicity. This suggestion is based on the fact that the chief toxic symptoms manifested in experimental animals after isonipecaine or local anesthetics administration are quite similar. These symptoms are referable to the central nervous system, consisting of restlessness and tremors which may proceed to clonic convulsions. For the treatment and prevention of poisoning by local anesthetics, Tatum and others^{10, 11, 12} have indicated that the barbiturates are the preferable agents to employ.

These studies will be described in greater detail elsewhere. We have also initiated studies on the possible applications of isonipecaine suggested above, and we hope to report on them soon.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

INTRAVENOUS TUBING FOR PARENTERAL THERAPY

CONTINUOUS or frequently repeated intravenous treatment is often complicated by trauma and thrombosis to the extent that all available superficial veins become destroyed. The discomfort of numerous venepunctures may also become a serious problem, particularly in uncooperative or disoriented patients. These difficulties can largely be avoided by the use of flexible plastic tubing which can be inserted into a vein through a needle and left in place as long as required. This method has been used extensively on dogs in which the leg veins, external jugulars and even portal vein have been employed for continuous and intermittent infusions. In 11 dogs the tubes have remained in the external jugular veins for 4 to 5 weeks without untoward developments.

In 4 such dogs which were recently sacrificed for

post-mortem study, the veins were thrombosed around the tube in 2, while in the remaining 2 the vein remained patent. Whether thrombosis is related to the mere presence of the catheter or to the irritating solution which was introduced daily through it has not yet been determined.

The following technique is recommended for patients. The skin over the vein to be used is anesthetized with procaine; a tourniquet is applied, and a 15-gauge needle is introduced. The flexible tubing is then threaded through the needle into the vein for a distance of 5 to 6 cm. The needle is removed over the tube, while the latter is held by pressure with the fingers over the vein. The point of entrance is covered with collodion and the free portion of the tubing

⁷ T. C. R. Shen and M. A. Simon, *Comp. Rend. de la Soc. de Biol.*, 127: 1457, 1938.

⁸ C. L. Burstein and B. A. Marangoni, *Proc. Soc. Exp. Biol. and Med.*, 43: 210, 1940.

⁹ A. M. E. Duguid and R. St. A. Heathcote, *Quart. Jour. Pharm. and Pharmacol.*, 13: 318, 1940.

¹⁰ A. L. Tatum, A. J. Atkinson and K. H. Collins, *Jour. Am. Med. Assn.*, 84: 1177, 1925.

¹¹ A. L. Tatum and K. H. Collins, *Arch. Int. Med.*, 38: 405, 1926.

¹² P. K. Knoefel, R. P. Herwick and A. S. Loevenhart, *Jour. Pharmacol. and Exp. Ther.*, 39: 397, 1930.

⁴ T. H. Rider, *Jour. Pharmacol. and Exp. Ther.*, 39: 329, 1930.

⁵ F. R. Mautz, *Jour. Thorac. Surg.*, 5: 612, 1935-36.

⁶ C. S. Beck and F. R. Mautz, *Ann. Surg.*, 106: 525, 1937.

⁶ C. J. Wiggers and R. Wegria, *Am. Jour. Physiol.*, 131: 296, 1940.

is secured to the skin with adhesive tape. A 20-gauge needle, the bevelled point of which has been ground off, provides a suitable adapter for connecting the end of the tube to the intravenous apparatus. When not in use the cannula is plugged with a large sterile pin. The plastic tolerates boiling or sterilization with 70 per cent. alcohol.

Suc's cannulae have been used for continuous intravenous penicillin therapy, for the infusion of glucose and saline solutions and for a total intravenous feeding with a mixture of 10 per cent. glucose, amino acids and vitamins. Although the longest time the same cannula has been left in place is 12 days, it should be possible, with proper care, to keep them in for much longer periods. There is no tendency for the tubes to become plugged even when they are not used for several days. Thrombosis of the vein itself, on the other hand, occurs when concentrated or otherwise irritating solutions are infused for extended periods. Although the method appears to be of definite value in selected cases, further investigation regarding both technique and materials must be completed before its general clinical use can be safely recommended.

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A DEVICE FOR MEASURING AVENA COLEOPTILE CURVATURE

A TRANSPARENT celluloid protractor with a movable arm attached at the center of the base is commonly used in hormone research for measuring *Avena* coleoptile curvatures. This instrument is somewhat difficult to use accurately because it is necessary to orient the coleoptile shadow picture while looking through two thicknesses of celluloid. The contacting surfaces of the protractor and movable arm become dulled with use and may become somewhat translucent instead of clearly transparent. At the base of the protractor and movable arm there are a considerable number of lines, which also adds confusion when using the device.

A simple measuring scale was developed to overcome the above difficulties. This device consists of a series of carefully constructed angles which are photographed and then printed on contrast process Ortho film to give narrow black lines on transparent celluloid. Fig. 1 illustrates this measuring scale, which is 3×5 inches. This device is used by moving it laterally over the shadowgraph of the curved coleoptile being measured, until the bottom and top of the coleoptile are oriented parallel with the bottom and top lines of one of the angles. The degree numbers at the top of the angle lines are written in both direc-

tions so that by turning the scale over either positive or negative curvatures may be measured.

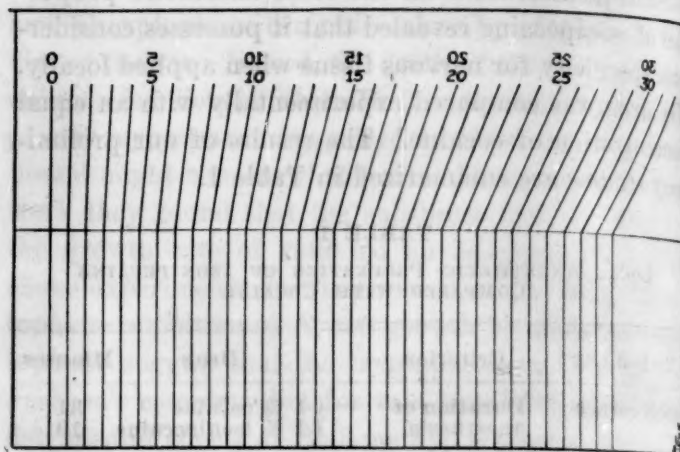


Fig. 1. *Avena* coleoptile curvature measuring device.

The measurement of coleoptile curvatures with this device is rapid and accurate. The scale illustrated in Fig. 1 contains angles from 1 to 32 degrees and covers the majority of reliable curvatures encountered in *Avena* tests. A second scale (not illustrated) contains angles from 25 to 57 degrees.

The measuring device has been used in the research laboratories of Dr. G. S. Avery, Jr., at Connecticut College for several years, and by a number of other laboratories where hormone tests are conducted.

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